

# Colloidal nanocrystals to advance catalysis and energy technologies

**Raffaella Buonsanti**

*Laboratory of Nanochemistry for Energy Research, Institute of Chemical Sciences and Engineering,  
Ecole Polytechnique Fédérale de Lausanne, Sion CH-1950, Switzerland.*

Affordable clean energy and climate action are two of the sustainable development goals set by the United Nations to be achieved by 2030. The vast majority of energy technologies relies on nanomaterials. The progress of these technologies is strongly connected to the ability of inorganic chemists to tune the function-dictating features of nanomaterials. (i.e. size, composition, composition, morphology).

In this talk, I will present our recent group efforts towards the synthesis via colloidal chemistry of atomically defined nanocrystals (NCs) which helps addressing current challenges in catalysis and energy conversion.

The first part will focus on our studies on Cu NCs as one example. I will illustrate how these NCs with precisely tunable shapes, sizes and interfaces serve as ideal platforms to advance our current knowledge towards improved selectivity and stability in the electrochemical CO<sub>2</sub> and CO reduction reactions. I will then share our results evidencing that these NCs can sustain their catalytic behavior at technologically relevant conditions, therefore might also offer practical solutions.

The second part will be dedicated to our colloidal atomic layer deposition (c-ALD) method to grow hybrid materials including NCs surrounded by an oxide shell embedding organic ligands. The oxide shells confer the NC with improved chemical stability and enable further functionalization and post-processing. I will discuss the formation mechanism of the shell by sharing our insight into the surface chemistry. I will then present how we manipulated the growth process in order to incorporate photoactive ligands around semiconductor NCs to create funnel structures with potential applications as photocatalysts and sensitizers for incoherent photon conversion. I will close the talk by going back to CO<sub>2</sub>RR to show that growing these oxide shells around metallic NCs creates electrocatalysts which are stable against reconstruction and show stable performance under cathodic conditions.